

# **UNITED STATES PATENT APPLICATION**

**Charles Hayes**  
Inventor

## **SYSTEM AND METHOD FOR OZONATING WATER FOR ANIMAL HOUSES**

**RHODES, COATS & BENNETT, L.L.P.**

909 Glenwood Avenue  
P.O. Box 5  
Raleigh, NC 27602  
(919) 832-3946

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# **SYSTEM AND METHOD FOR OZONATING WATER FOR ANIMAL HOUSES**

## **FIELD OF THE INVENTION**

The present invention relates to the reduction of pathogen concentrations in drinking water supplies and more particularly to the elimination of pathogens in the potable water supply of animal houses through the utilization of an ozone-based water treatment system.

## **BACKGROUND OF THE INVENTION**

The cost of ancillary goods and services associated with poultry production has continuously escalated over the past two decades, while retail poultry prices have remained relatively stable. As a consequence, there has been and continues to be significant pressure on poultry producers to develop new technology and production methodologies aimed at reducing costs by way of increasing overall production efficiency.

Two areas of particular interest to commercial poultry producers, with regard to their flock, are feed conversion ratios and bird mortality rates. Feed conversion ratio relates the amount of feed consumed to the amount of dressed, final product, and bird mortality rates relate to the premature death and hence, complete loss of the intended final product. Poultry farmers strive to maximize feed conversion ratios, and minimize bird mortality rates, as optimizing either of these parameters would ultimately lead to lower overall production costs and hence greater profit margins.

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One major factor, relevant to both feed conversion ratios and bird mortality rates, is the ambient pathogen concentration within the water supply that is directed to the poultry house and consumed by the birds. It has been well documented, through extensive research, that higher ambient pathogen levels generally lead to less than optimal feed conversion ratios, while leading to higher than optimal mortality rates. Therefore, it is reasonable to assume that generally lowering ambient pathogen concentrations within the feed water supply would lead to improvements in both the feed conversion ratios and mortality rates, and hence would, lead to a generally more cost efficient operation.

While water treatment systems that utilize ozone as the active disinfecting agent have been used previously, these systems generally require that the volume of water being treated should be maintained at or near atmospheric pressure as the ozone is effectively bubbled therethrough. Typically, this requires that the water taken from a water main be dropped from street pressure to atmospheric pressure prior to treatment. Furthermore, following ozonation treatment, the volume of treated water must then be re-pressurized so that the treated water may be effectively pumped to the desired locations and dispersed. This is expensive, as the system must be provided with both a non-pressurized treating and holding tank and a final pressurized tank.

Therefore, there is a need for an ozone water treating system that is relatively simple in design and economical to operate and which generally minimizes the number of tanks and the amount of hardware required.

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## SUMMARY OF THE INVENTION

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The present invention entails a pressurized system for treating water with ozone. Water from a pressurized source is directed into a pressurized ozone treatment tank. Operatively connected to the pressurized ozone treatment tank is an ozone mixing and re-circulation loop that provides for the flow of water from the ozone treatment tank, through the loop, and back to the pressurized ozone treatment tank. Disposed in the loop is an ozone injector that is coupled to an ozone generator. Further disposed within the loop is a booster pump that is connected on the inlet side of the ozone injector and between the injector and the ozone treatment tank. The booster pump functions to pump water from the ozone treatment tank and to boost the pressure of the water prior to the water entering the ozone injector. The presence of the booster pump causes a pressure drop across the injector and this pressure drop causes ozone to be induced into the circulation loop and to mix with the water being circulated through the loop. Thus, the ozone injector functions to create a water-ozone mixture that is directed from the injector back into the pressurized ozone treatment tank. From the ozone treatment tank, the treated water is directed to a watering area where the treated water is consumed by animals, such as chickens.

In a specific embodiment of the present invention, there is provided a flow switch that forms a part of the ozone treating system. The flow switch effectively senses the flow of water from a water source into the ozone treatment tank. Upon the sensing of this flow, the flow switch in turn actuates the booster pump

which in turn starts the re-circulation of water from the tank through the ozone mixing and re-circulating loop. In one embodiment the flow switch is operatively connected to the ozone generator and acts to actuate the same in response to there being water flow from the water source to the ozone treatment tank. In this embodiment, a timer control may be employed so as to maintain the booster pump and/or the ozone generator in an operative mode for a predetermined time period after the flow of water from the source to the tank has ceased.

It is therefore an object of the present invention to provide a system for ozonating water for consumption by animals wherein the system is a pressurized system.

Other objects and advantages of the present invention will become apparent and obvious from a study of the following description and the accompanying drawings, which are merely illustrative of such invention.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**Figure 1** is a schematic diagram illustrating the animal house feed water ozonation system of the present invention.

### **DETAILED DESCRIPTION OF THE INVENTION**

Shown in **Figure 1** is a schematic illustration of the poultry house feed water ozonation system of the present invention, generally indicated by the numeral **10**. Ozonation system **10** includes a main inlet line **12** that leads from a pressurized water supply to a flow switch **14**. From the flow switch **14**, a second

inlet line **16** leads to a pressurized treatment or contact tank **18**. Contact tank **18** is disposed to receive and contain a relatively large reservoir of water at or near the pressure of the supplying water main **12**, which typically would be in the range of 35 to 65 psi. Tank **18** connects to a re-circulation outlet line **20**, a re-circulation inlet line **22**, a pressure relief valve **24**, and a main outlet line **46** with an associated filter element **48**.

In addition to controlling the flow of raw, untreated water into the contact tank **18**, flow switch **14** is also configured so as to actuate a re-circulation control unit **28**, where control unit **28** is communicatively coupled to and controls ~~of~~ an associated re-circulation booster pump **30**. Booster pump **30** takes input from the contact tank **18** via the re-circulation outlet line **20**, which includes an in-line check valve **26**. Configured so as to control the effective outlet pressure of the re-circulation booster pump **30** is a pressure regulator **32**.

Outlet pressure of the re-circulation booster pump **30** is monitored by a first pressure gauge **40**. Adjacent and downstream of gauge **40** is a venturi-type ozone injector **36**. Ozone is supplied via an associated ozone generator **34** which is coupled to the injector **36** through a flow-metering valve **38**. Actuation of the ozone generator **34** is facilitated by the same control unit **28** that is responsible for actuation and control of the re-circulation booster pump **30**.

Adjacent and downstream of the injector **36** is a second pressure gauge **42**, which is effectively situated between the injector **36** and the contact tank **18**. Also, disposed in-line between the pressure gauge **42** and the contact tank **18** is a second check valve **44**.

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Under typical operating conditions, raw or untreated water is supplied to the treatment system **10** from a water main **12** at a pressure greater than atmospheric pressure. More particularly, the pressurized, untreated water from inlet **12** enters the treatment system **10** via the flow switch or valve **14**, as indicated in Figure 1. When flow switch **14** is maintained in a closed configuration, no untreated water is permitted to flow from the inlet main **12** and into the adjacent contact tank **18** which is located downstream. Upon actuation of the flow switch **14**, the inlet main **12** is effectively coupled to the contact tank **18** via the raw water inlet line **16**, thus allowing the untreated, pressurized water to flow from the inlet main through to the tank **18**. As such, the contact tank **18** is allowed to fill with water, with the tank contents being brought to the same pressure as that of the inlet main **12**. It will be appreciated that the pressure relief valve **24**, which is incorporated into the contact tank structure, provides the only pathway for venting the tank contents to the ambient atmosphere. In practice, the pressure relief valve **24** is designed so as to open at a set point that is slightly greater than the operating pressure of the supplying water main **12**. As a result, the pressure of the contact tank contents is maintained at or near the pressure of the supplying water main **12**.

Returning now to the discussion of flow switch **14** actuation, it will be appreciated that in addition to permitting flow into the tank **18** from the inlet main **12**, actuation of the switch **14** causes a secondary actuation of the associated re-circulation control unit **28**. The re-circulation control unit **28** is, in turn, responsible for actuating both the re-circulation booster pump **30** and the ozone

generator **34**. It should be appreciated that in the preferred embodiment considered herein, the control unit **28** may be configured to continue actuation of the booster pump **30** and ozone generator **34** even after the flow switch **14** has been closed or de-actuated. More particularly, the control unit **28** may include a timer feature, which allows the booster pump **30** and ozone generator **34** to remain actuated for a certain pre-determined interval of time following closure or de-actuation of the flow switch **14**.

When actuated, the re-circulation booster pump **30** draws water from the contact tank **18** via the re-circulation outlet line **20**. As water from the contact tank **18** is drawn into and through pump **30**, the pressure of the fluid passing therethrough is raised to a level that is greater than that of the contact tank **18**. The resulting, elevated outlet pressure of the booster pump **30** is controlled via the associated pressure regulator **32**. This pressure regulator **32** effectively controls the pressure at the pump outlet by diverting and re-circulating a portion of the fluid passing through the pump **30**. By varying the amount of fluid that is diverted and re-circulated to the pump inlet, the pressure at the pump outlet may be adjusted accordingly. As pressure regulators of this type are commonly known to those skilled in the art, a more detailed description of the operating principles of such a regulator will not be presented herein. Instead, it will suffice to state that the pressure at the outlet of the re-circulation booster pump **30** is effectively controlled by the action of the associated pressure regulator **32**.

The water issued from the outlet of the re-circulation booster pump **30**, which has now been raised to a pressure greater than that of the contact tank



18, is then passed through the venturi-type injector 36. It is at the injector 36 that gaseous ozone supplied by the ozone generator 34 is introduced into the stream of water passing therethrough. As such venturi-type injectors and related devices which operate based on the venturi effect are well known to those skilled in the art, only a brief discussion of injector 36 operating principles will be presented herein.

Typical operation of the venturi injector 36 requires that a pressure differential of at least approximately 15% be established and maintained between the inlet and outlet of the injector 36. As discussed above, this pressure differential is created by the re-circulation booster pump 30, and effectively controlled by the associated pressure regulator 32. The pair of pressure gauges 40 and 42 are used to monitor and assist in the adjustment of the regulator 32 so as to establish the desired 15% pressure differential across the injector 36. The establishment and maintenance of this pressure gradient across the injector 36 necessarily results in the flow of water through the injector 36. As the water flows through the injector 36, a relatively low pressure is developed across a venturi inlet tap (not shown) associated with the injector 36 which acts to draw ozone from the adjacent generator 34 into the injector 36. Once drawn into the injector 36 via the venturi inlet tap, the gaseous ozone is mixed with the water flowing therethrough, and becomes effectively incorporated into the flow stream.

Typically, the stream of ozone gas produced by the ozone generator 34 is comprised of approximately 95.0% to 99.2% air and approximately 0.8% to 5.0%

pure ozone. This relatively dilute ozone-air mixture is then introduced into the water flow stream via the injector **36** at a rate of approximately 2 to 6 liters per minute. As shown in Figure **1**, the control of the ozone injection rate is provided by the ozone flow-metering valve **38**.

Upon exiting the injector **36**, the ozone-rich stream of water passes first through check valve **44** and then back into the contact tank **18** via the recirculation inlet line **22**. It should be appreciated that besides providing a pathway for water flow back into the tank **18**, the inlet line **22** also serves to generally disperse the ozone-rich water within the tank **18**. That is, the inlet line **22** is typically configured so as to facilitate or expedite mixing of the ozone-rich water throughout the volume of the tank **18**, so as to achieve a uniform or near uniform distribution of ozone within the contents of the tank **18**.

As the injected ozone accumulates in the contact tank **18** and is permitted to thoroughly mix with the water contained therein, disinfection and reduction of pathogen levels within tank water occurs. However, accumulation of the ozone in the contact tank **18** may act to raise the pressure within the tank **18**. In response to this elevation in internal pressure, the relief valve **24** is configured to open and effectively vent this build-up of excess pressure to the ambient atmosphere. More particularly, it is the ozone-air mixture that is introduced via the injector **36** which is released to the atmosphere. It should be appreciated that although the ozone is vented to the atmosphere via the relief valve present in the contact tank **18**, the overall treatment system **10** is designed such that the ozone-air mixture is able to remain in contact with the tank water for a period that

is long enough to insure disinfection or reduction of pathogen concentrations to a safe or acceptable level.

As treated water is required, the contents of the tank **18** are drawn out the main outlet line **46** and through the associated filter **48**, which removes any bulk or granular material from the flow stream prior to end use of the water. Once again, it should be appreciated that the contents of the contact tank **18** are maintained at the pressure of the inlet main **12** as a consequence of the direct coupling of the tank **18** to the water main **12**. Therefore, additional or auxiliary pumping means are not required to raise or maintain the pressure of contact tank **18** to a level suitable for allowing distribution throughout an associated animal house or houses. That is, as designed, the treatment system **10** only requires the water main **12** to source and maintain the pressure required for normal water distribution operations. For example, in the case where the water main **12** is a pipe connected to a conventional or standard public water system, the burden and associated expense of generating and maintaining nominal water line pressure falls squarely on the public water works system. The benefit of such a system configuration is more fully appreciated when it is considered that the size and operating expense of the booster pump **30** is typically much smaller than the equipment that would be required to provide the same function as the public water system pumps.

Herein, the word water has been used to describe the fluid contained within the contact tank **18** and also, has been used to describe the fluid that is

circulated through the system of the present invention. As used herein, the word or term water means water or a mixture of water and ozone.

In Figure 1, the flow switch 14 is disposed in the water inlet line. It should be appreciated however, that the flow switch 14 can be located in other locations, for example, the flow switch 14 could be disposed between the contact tank 18 and the filter 48. In addition in the schematic of Figure 1, there is shown a number of check valves. Depending upon the orientation of the pump 30, certain check valves shown in the schematic of Figure 1 may not be required. For example, the pump can be elevated to such a degree that in some flow lines there would be no need for the provision of a check valve.

In addition, the present invention has been disclosed herein in connection with ozonating water for animal houses. It should be appreciated, however, that the present system and process can be utilized for a wide range of applications including applications for disinfecting water that is utilized to clean and disinfect objects. Moreover, the system and method disclosed herein for ozonating water can be utilized for treating residential water supplies as well as treating water used in many applications other than for animal houses.

The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the spirit and the essential characteristics of the invention. The present embodiments are therefore to be construed in all aspects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.